

Beyond Spitzer: Closing Remarks

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10 June 2004

The Vision for Space Exploration

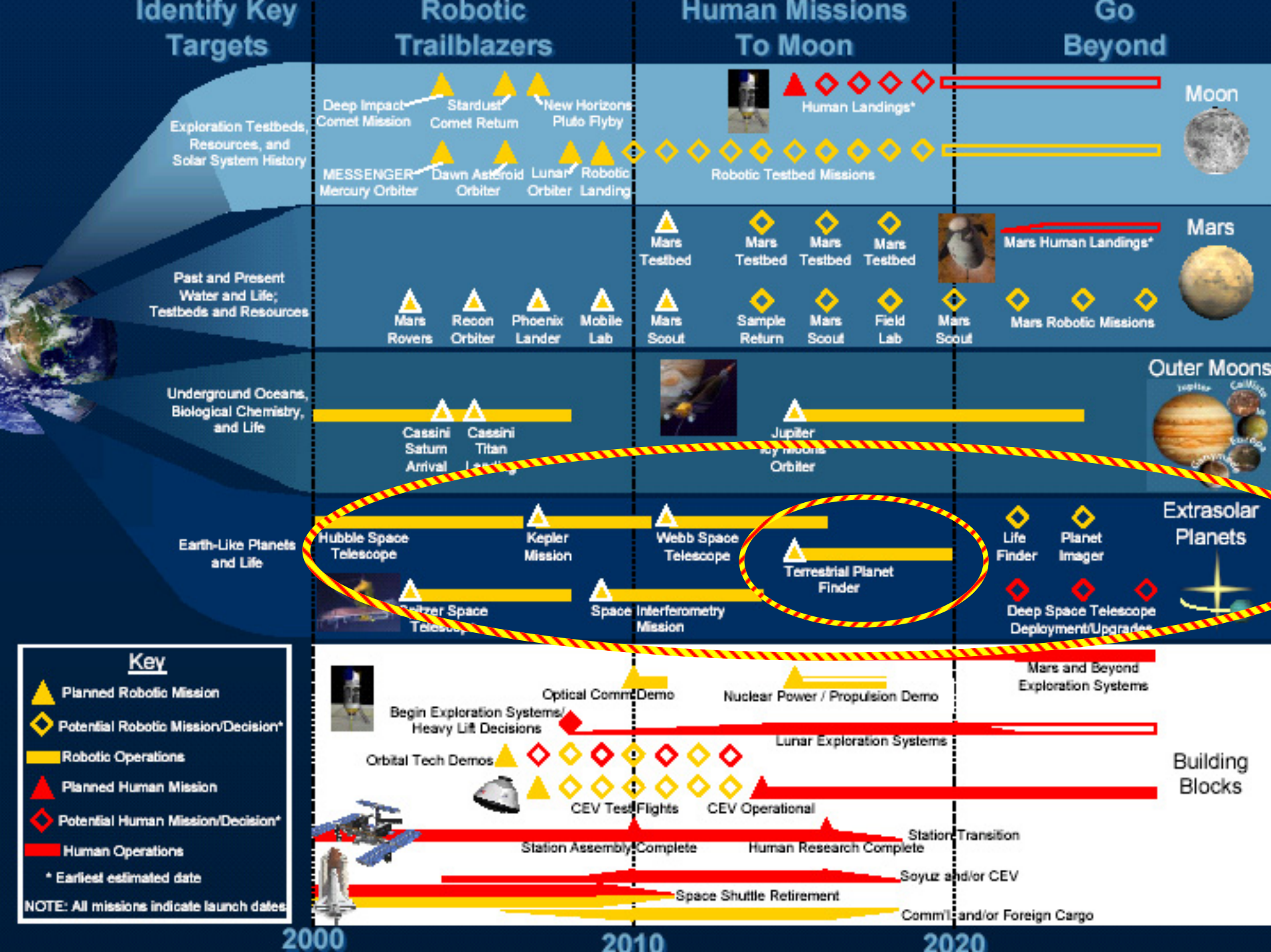
- Focus on manned mission to Moon and Mars, robotic exploration of solar system, and search for life around other stars
- Among ~20 specific goals the President set for NASA is the following:
 - *“Conduct advanced telescope searches for Earth-like planets and habitable environments around other stars”*

A RENEWED SPIRIT OF DISCOVERY

*The President's Vision for
U.S. Space Exploration*



PRESIDENT GEORGE W. BUSH
JANUARY 2004



TPF Architecture Selection (1975-2004)

Ball

Coronagraphs 7
Occulting screens 2
Nulling interferometers 10
Hypertelescopes 2

Boeing-SVS

Coronagraphs 7
Hypertelescope 3
Interferometers 3
Laser-trapped ion mirror 1

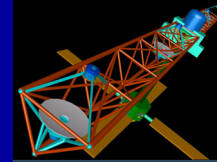
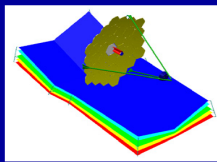
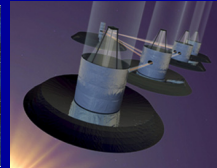
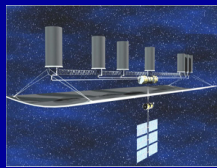
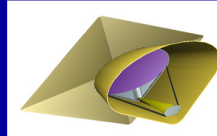
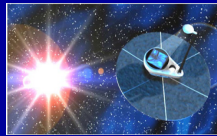
Lockheed-Martin

Free-flying interferometers 4
Fizeau interferometer 1
Structurally connected interferometers 3
Tethered interferometers 1
Coronagraphs 1

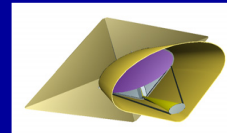
TRW (now NGST)

Large-aperture IR coronagraph 3
Fresnel coronagraph- free flying 1
100-m sparse aperture 1
Free-flying occulter 1
Structurally connected interferometer 1
Separated spacecraft interferometer 7

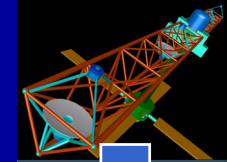
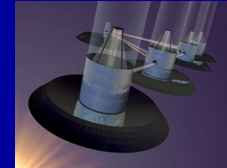
2000



2001



2002



2004



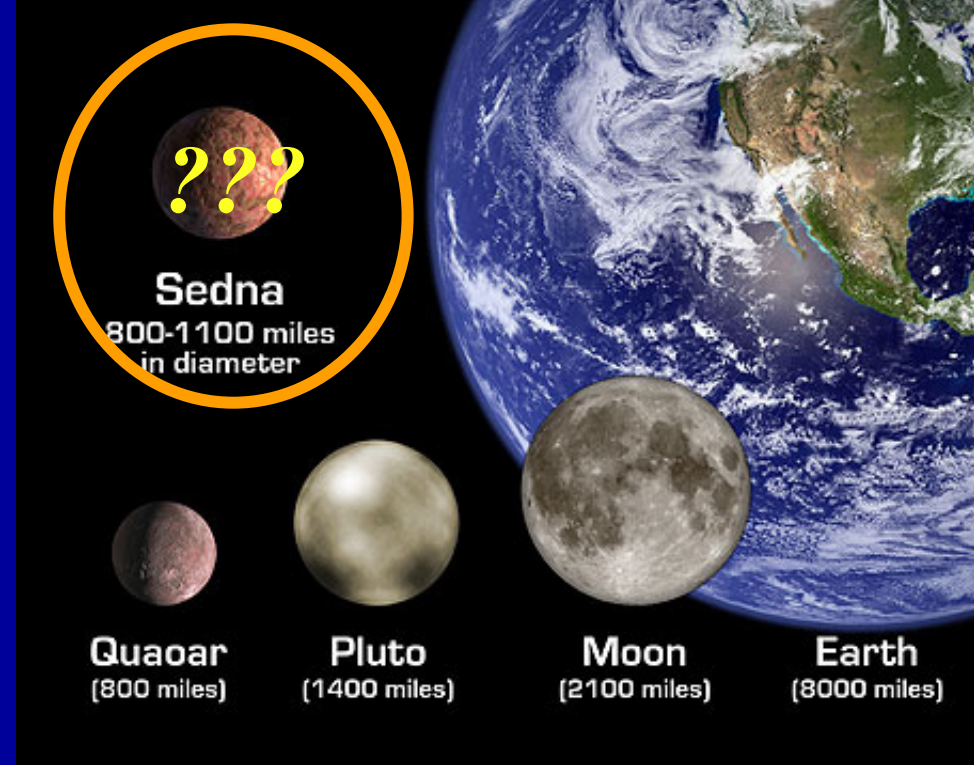
*Visible Coronagraph,
4x6m telescope*



*Formation Flying
Interferometer 3-30 μm ,
50-250 m baseline*

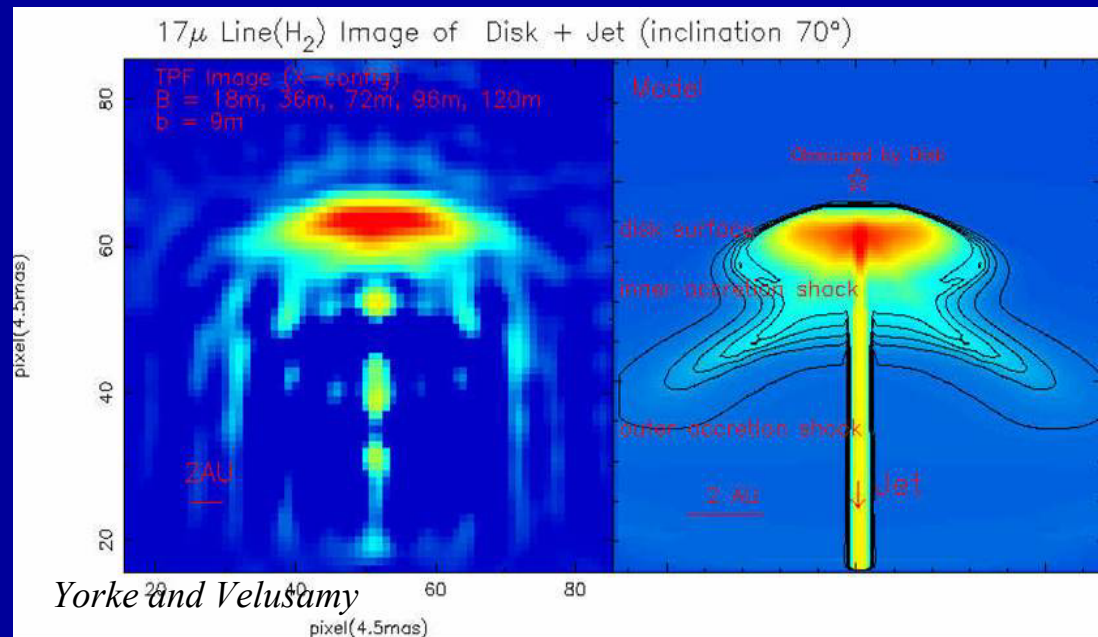
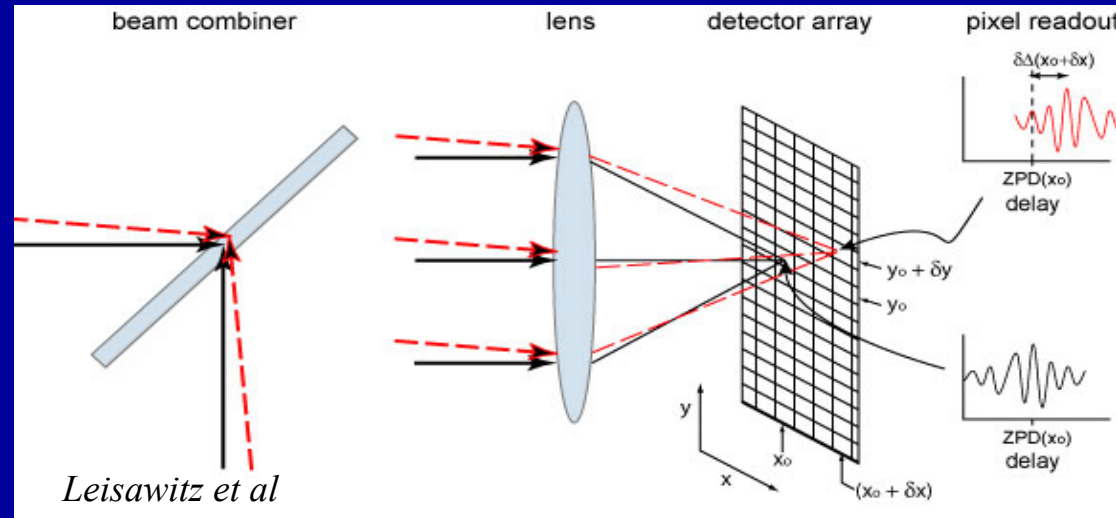
Why Fly a Coronagraph and an Interferometer?

- *Most compelling science*
 - Data from *both* visible and mid-IR wavelength regions will provide *complete* planet characterization, *definitive* assessment of habitability, and *unambiguous* biomarkers
- Technology for starlight suppression has matured to enable a scientifically robust approach with two *complementary* missions in the next decade
 - *Deliver results as rapidly as possible* --- A moderate-sized, visible light coronagraph in 2014
 - *Provide confirming, complementary, expanded results later*--- a formation-flying, mid-infrared interferometer jointly with ESA in 2019



Extended Operating Modes for TPF-I

- Extending operation of TPF-Interferometer to shorter and longer wavelengths (3-30 μm) and longer baselines (>250 m) would revolutionize study of star formation with 3-30 mas imaging (0.5 AU in Taurus)
- An imaging spectroscopic beam combiner would allow $\sim 10\text{-}30''$ FOV with $R \sim 100\text{-}1000$ resolution to study gas (ionized and atomic gas and molecules including H_2) and dust in obscured star and planet forming regions as well as AGN and starburst galaxies



The Competition

- Strategic Missions (\$1-\$5B)
 - Need a major push from the Administration, from NASA, and Decadal Committee to put one into the program.
 - Must have a sound bite (planets, life, gravity, kids love it...).
 - “Good” Science not enough. Think SSC (=Superconducting Super Collider)
 - Existing projects
 - HST Servicing Mission 4 and 5. \$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$ → ∞
 - SIM
 - JWST
 - Strongly desired (by somebody) future projects
 - TPF-C/TPF-I
 - LISA
 - Con-X
- Origins Probes (\$0.5-\$1B; IRAS, COBE, Spitzer-scale)
 - NASA likes competed missions of this size scale
 - Einstein Probes selected, not yet funded
 - We even like CMBPOL and Near-IR focal plane on SNAP/JDEM
- Explorer (\$0.2-0.5B)
 - Low funding level for what we want, but niches exist and should be fully exploited, e.g. WISE

The 1990s Were About Vision. The 2000s Are About Budgets.

- Support our existing program
 - JWST/MIRI is threatened everyday
 - WISE is hovering at the edge, especially given recent Explorer cuts
 - IR Interferometry could go to Europe, or vanish
- *Identify one or more Origins probes to give NASA a strong scientific reason to push for the program*
 - These missions have the best chance for funding on purely scientific grounds
 - We must influence the Strategic Planning process just getting underway
- Identify a strategic mission to interest the technologists
 - Vision → **Technology ↔ Science ↔ Politics (\$)** → Mission
 - These have a small chance for funding (now) on purely scientific grounds, but a reasonable chance for keep-alive technology funding
 - Detectors are a hard sell to NASA technology community which is presently focused on Lunar/Mars Exploration